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Separating evapotranspiration into its components using the three-temperature model and thermal remote sensing

Yu Jiu Xiong
Sun Yat-Sen University, School of Civil Engineering, Guangzhou, China (xiongyuj@mail.sysu.edu.cn)

Hydrological variables are difficult to observe and estimate, particularly evapotranspiration (ET), because of the large number of controlling factors that are involved, such as plant biophysics, soil water, and atmospheric conditions. In addition, separating ET into soil evaporation (Es) and vegetation transpiration (Ec) is difficult. Here, we focused on ET components estimation using a three-temperature model and multi-scale thermal remote sensing data. The method was tested in a heterogeneous oasis in northwestern China. The results showed that in the growing season, Ec/ET estimates of a maize field based on fluke thermal image was 92% in average, with maximum and minimum values of 94% and 88%, respectively, and the corresponding ASTER-based estimates were 90%, 96%, and 87%, respectively. Whereas the mean value of MODIS-based estimates was 59%. Validation results indicates that with relatively high spatial resolutions such as fluke images, ET components estimated from these remote sensing data and the 3T model are comparable to the isotope-based observations, whereas the MODIS-based Ec/ET estimates from the 3T model may be underestimated due to MODIS's poor ability to capture heterogeneity. It is concluded that the 3T model is useful to separate ET into Es and Ec.